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FILM FOR WRAPPING OBJECTS

Ins A1 The invention relates to an assembly comprising a solid and its wrapping, the ~~said~~ wrapping comprising at least one film comprising at least one twist wrap and/or one fold, the ~~said~~ film comprising at least one layer comprising at least one polyester. The invention relates directly to the field of wrapping for foodstuffs, for instance confectionery such as chocolates, sweets, raw sugars or caramels, chewing-gums and lollipops, as well as to that of any other solid object, for instance soaps, cheeses in portions and culinary additives in doses, for instance stock cubes. ~~Figures 1 and 2 show, for example, sweets after wrapping in the context of the present invention.~~

The wrapping with which the present application is concerned can thus be a film which fits directly around most, if not virtually all, of the surface of the wrapped solid, the latter generally consisting of a single component (in contrast, for example, with a powder consisting of several components in the form of particles), as is the case, for example, for a sweet. Needless to say, in the context of the present invention, the assembly can comprise

- the solid object,
- which is itself first wrapped with a first film or paper, which may be metallized,
- which is itself wrapped with the film comprising at least one twist wrap and/or one

fold and comprising at least one layer comprising at least one polyester.

Sub A2 According to the prior art, the sweets can be wrapped using films made of polyvinyl chloride (PVC) or of cellophane. PVC is generally being replaced and is moreover of high density, such that it makes batches of wrapped sweets substantially heavier. Cellophane is manufactured by a complex process which makes it expensive, and increasingly fewer manufacturers make it. There is thus a need for products to replace these two materials, in particular in the field of films for wrapping solid objects such as sweets.

A film which is suitable for wrapping a solid should satisfy several technical criteria.

In particular, the film should be suitable for wrapping, i.e. it should retain the shape given to it during wrapping with the least possible tendency to return to its original shape, i.e. that of a flat film. This property makes it possible to avoid having to use an adhesive or a glue, for example on the narrowest part of a twist wrap, i.e. between the wrapped solid and the twist wrap itself, in order to keep the wrapping in the shape given to it.

The film's tendency not to retain the shape which it has been attempted to give it is more particularly difficult to overcome when it is desired to give the wrapped solid one or more twist wraps, such as for the sweets represented in Figure 1.

The aptitude of a film to wrap a solid in order to produce a wrapping comprising at least one twist wrap and/or one fold can readily be tested by observing whether a twist wrap has a tendency to become undone once it has been formed. This test can be carried out by forming a twist wrap from a half-turn, i.e. by making the part of the film which does not hold the solid undergo a 1/2 turn relative to the wrapped solid.

A film for wrapping solid objects should also be easily manipulable by the machines responsible for wrapping the said objects, these machines being expected to run at the highest possible rates, for example 50 to 1500 objects wrapped per minute and per machine.

The film should also be easy to cut. The reason for this is that, before wrapping an object, it is necessary to cut out the area of film needed to wrap the said object, generally from a reel of the said film. Before wrapping the object, before and after mechanical cutting, the film should remain entirely flat and should show no tendency to roll up. Such a tendency could disrupt the production line and cause it to become blocked.

Furthermore, depending on the case, the film may need to have good sheen and/or suitable transparency, and/or correct suitability for contact with food and/or satisfactory organoleptic properties.

Where appropriate, the film should have correct suitability for printing and/or metallization. Furthermore, the film should be easy to manufacture from its raw materials.

A monomaterial film made of bioriented high-density polyethylene or of bioriented polypropylene does not satisfactorily meet the schedule of conditions for the application envisaged, in particular since it is relatively unsuitable for wrapping. Furthermore, these materials extruded by the ~~blew-moulding~~ blow-molding extrusion process, commonly known as the "bubble" process, have mediocre optical properties on account of the presence of nodules at the surface, which cause light to be diffracted.

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The film of the invention satisfies the above-mentioned problems. In particular, the film according to the invention allows a solid to be wrapped in wrapping comprising at least twist wrap and/or fold without it being necessary to use an adhesive or bonding agent. In particular, it is not necessary for the film itself to act as bonding agent, which would in some way be the case if the film was hot-sealed on itself to keep the wrapping sufficiently closed. Thus, the film according to the invention allows the production of a wrapping which is kept closed around an object merely by producing at least one twist wrap (also known as a "curlpaper") and/or at least one fold, without there being the obligatory need to use cold or

hot sealing at any point in the wrapping after enveloping the object. To produce this wrapping, it is no longer necessary either to attach to the film, and thus as an over-thickness to the said film, reinforcements such as, for example, foldable rods which may be metallic, so as to hold the wrapping around its contents by means of the nonelastic folds exerted on the said rods.

The film used in the context of the present invention comprises at least one layer comprising at least one polyester. It can thus be an essentially monolayer film or a multilayer film. This film generally has a thickness ranging from 5 to 100 µm and more generally from 10 to 60 µm.

The film is said to be essentially monolayer if its manufacture has required the extrusion of only a single thermoplastic material, even if, where appropriate, it has received the usual finishing layers, such as a layer of metallization and/or of printing and/or of coating with an antistatic agent, subsequent to the said extrusion.

The film is said to be multilayer in the context of the present application if it comprises at least two layers of different thermoplastic materials.

Preferably, the film comprises a plane of symmetry which is parallel to it, the said symmetry applying both to the geometry and to the composition of the film. This implies that if the film is multilayer

and comprises at least two layers of different composition, the film necessarily comprises at least three layers.

The sum of the mass of the layers comprising a polyester can represent at least 20% by weight of the mass of the film.

The film can consist of at least three main layers, one of which, which is of different composition to the other two, is found in the middle of the film, such that it includes the plane of symmetry of the film. The expression "three main layers" is understood to mean that the sum of the mass of these three layers constitutes at least 80% of the total mass of the film and that each of these three layers obtained from a thermoplastic material constitutes at least 10% by weight of the total mass of the film.

For the case of a film comprising at least three main layers in the sense given above, the middle layer can comprise at least one polyolefin and the other two layers, which are substantially identical, can comprise at least one polyester.

The film comprising at least three main layers in the sense given above has an excellent aptitude for tearing (substantially linear tearing) in all directions, in particular both in the direction of the coextrusion and in the direction perpendicular to that of coextrusion. The film is thus also particularly

suitable for applications requiring good tearability in the direction perpendicular to that of coextrusion.

Throughout the present application, whenever mention is made of a layer "based on" a certain material, this means that the layer comprises at least 60% by weight of the said material.

According to one variant, the film comprises at least one layer comprising at least one polyester and at least one layer comprising at least one polyolefin.

The film according to the invention preferably comprises at least one layer of polyester, the said film being essentially monolayer, or the said film being multilayer and in this case comprising at least one layer comprising at least one polyolefin.

The term polyolefin is understood to refer to a polymer of at least one olefin, the term polymer needing to be taken in the broad sense, such that it covers the notions of homopolymer, of copolymer, of terpolymer, of interpolymer, or of a mixture of polymers. As olefin, mention may be made of ethylene, propylene, butene, hexene and 1-octene. As polyolefin, a propylene or ethylene polymer is preferred, the latter being even more preferred. The polymer of at least one olefin can thus come from the polymerization of at least one olefin with at least one other monomer, which can be an olefin or another monomer such as, for example, vinyl acetate, maleic anhydride or an acrylic ester.

For the case of a film comprising at least three main layers in the sense given above, the middle layer is advantageously based on an ethylene polymer. This ethylene polymer can be such that at least 80% of the monomer units constituting it are ethylene.

The term polyester is understood to refer to a polymer comprising at least one ester function as repeating unit, the term polymer here also covering the notions of homopolymer, of copolymer, of terpolymer, of interpolymer and of a mixture of polymers.

The polyester can come from the condensation of terephthalic acid with at least one diol.

The polyester can be chosen from amorphous and semicrystalline polyesters. The term "amorphous" means that the polyester has less than 15% crystallinity and preferably less than 10% crystallinity.

Amorphous and semicrystalline polyesters can be produced by processes that are known per se. Thus, amorphous polyesters are usually produced by melt phase techniques and crystalline polyesters are usually produced by a combination of melt phase and solid phase polycondensation procedures.

Preferably, the polyester is amorphous.

A polyester is usually prepared by polycondensation of one or more diacid(s) (also known as dibasic acid) with one or more diol(s) (also known as glycol(s)). It is recalled that a polyester obtained from a polycondensation medium comprising terephthalic

acid and ethylene glycol is usually known as "polyethylene terephthalate" and usually denoted by the abbreviation "PET".

A preferred polyester is a copolymer which can come from the condensation (also known as polycondensation) of terephthalic acid with ethylene glycol and a diol comprising at least three carbon atoms. Such a polyester is usually known as "polyethylene terephthalate glycol" and usually denoted by the abbreviation "PETG".

This means that the polycondensation medium comprises terephthalic acid, ethylene glycol, a diol comprising at least three carbon atoms and, if necessary, other diacids and/or other diols.

One polyester which is particularly suitable is a copolymer derived from the copolymerization (in fact polycondensation) of terephthalic acid with ethylene glycol and cyclohexanedimethanol, in particular when it is amorphous. This means that the polycondensation medium comprises terephthalic acid, ethylene glycol, cyclohexanedimethanol and, if necessary, other diacids and/or other diols, the final polyester being more particularly suitable when it is amorphous.

Thus, the diacid component of the polyester can comprise 70 to 100 mol% of terephthalic acid and 0 to 30 mol% of another acid chosen from isophthalic acid, naphthalenedicarboxylic acid and 1,4-cyclohexanedicarboxylic acid or mixtures thereof.

Preferably, the diacid component contains from 80 to 100 mol% of terephthalic acid and 0 to 20 mol% of isophthalic acid.

The diacid component can be modified by a small amount, i.e. up to 10 mol%, of a diacid containing 4 to 40 carbon atoms, such as an isomer of naphthalenedi-carboxylic acid or mixtures thereof, the 1,4-, 1,5-, 2,6- and 2,7-isomers being preferred, or such as a cis or trans isomer or a mixture of cis/trans isomers of 1,4-cyclohexanedicarboxylic acid, or such as sulpho-isophthalic acid.

The diol component of the polyester can be derived from diols (i.e. glycols) comprising 2 to 10 carbon atoms, and mixtures thereof. Preferably, the diol component contains 2 to 99 mol% of 1,4-cyclo-hexanedimethanol and from 1 to 98 mol% of ethylene glycol, and preferably 25 to 40 mol% of 1,4-cyclo-hexanedimethanol and 75 to 60 mol% of ethylene glycol.

The diol component can be modified with up to 20 mol% of other glycols such as diethylene glycol, neopentyl glycol, 1,4-butanediol, 1,5-pentanediol, 1,6-hexanediol, 1,8-octanediol, 2,2,4-trimethyl-1,3-pentanediol, propylene glycol or 1,3-propylenediol.

The polyester can be chosen from those whose intrinsic viscosity ranges from 0.4 to 1.5 dL/g, and preferably from 0.6 to 1.2 dL/g, the said viscosity being determined at 25°C using 0.25 g of polymer per

100 ml of a solvent composed of 60% by weight of phenol and 40% by weight of tetrachloroethane.

For the case of a film comprising at least three main layers in the sense given above, the middle layer can represent 40 to 80% by weight of the mass of the film.

For the case of a film comprising at least three main layers in the sense defined above, mention may be made, for example, of the combination in which the middle layer is based on an ethylene polymer and represents from 40 to 80% by weight of the mass of the film, each of the other two layers being based on a polyester which is a copolymer derived from the condensation of terephthalic acid with ethylene glycol and a diol comprising at least three carbon atoms, each of these two other layers representing from 10 to 30% of the mass of the film, the said polyester preferably being amorphous, and the said diol comprising at least three carbon atoms and possibly being cyclohexanedimethanol.

Where appropriate, when the film is multilayer, the film can comprise one or more binders, interface-adhesion promoters, between the various layers. Such binders are generally present between the layers of the film in an amount of from 1 to 5 µm.

It is also possible to mix one or more binder(s) with at least one of the materials constituting at least one of the layers of the film, so

as to increase the compatibility and thus the adhesion of the said layer to at least one of the layers adjacent to it. Generally, such a binder can be present in the chosen layer in a proportion of from 10 to 40% by weight.

Needless to say, at least one of the ingredients (binder and/or thermoplastic resin) which are useful for manufacturing the film can contain at least one adjuvant or additive, such as a dye or pigment, antioxidant, anti-UV agent, release agent or antiblocking agent, incorporated in the usual manner and known to those skilled in the art, taking into account the ingredient chosen. For the case of a multilayer film and when this film is intended to wrap a foodstuff, it may be preferred, depending on the case, to incorporate the adjuvant or additive into the middle layer of the film, if it is desired to lower the risk of contamination of the foodstuff finally wrapped, by the said adjuvant or additive.

At least one release agent can be incorporated into at least one ingredient of the film, prior to its preparation by extrusion or coextrusion. If the film is multilayer, the release agent is preferably incorporated into the outermost coextruded layers. Such a release agent can be chosen, for example, from fatty acid amides such as erucamide and can be introduced in a proportion of from 200 to 5000 ppm into the

thermoplastic material from which the layer(s) of the film containing this release agent will be obtained.

In general, such a release agent is incorporated into the film if there is no intention to metallize it or to print on it.

At least one antiblocking agent can be incorporated into at least one ingredient of the film, prior to its preparation by extrusion or coextrusion.

When the film comprises several layers, the antiblocking agent is preferably introduced so as to be present towards the outer layers of the film, for example the two outermost layers which have been coextruded, but which are found just beneath the non-coextruded layer(s), i.e. the layers of printing and/or of metallization and/or of coating with an antistatic agent, if the latter operations are intended.

The function of this antiblocking agent is to lower the tendency of the film to adhere to itself when it is wound on a reel, so as to facilitate its unwinding. Such an antiblocking agent generally comprises inorganic filler particles such as silica and can be incorporated into at least one of the layers in the form of an inorganic filler/thermoplastic resin master mixture.

When the antiblocking agent comprises an inorganic filler, the antiblocking agent can be incorporated into at least one layer such that the

inorganic filler is present in the said layer in a proportion of from 100 to 10,000 ppm.

Prior to its use for wrapping objects, it is possible to give the film antistatic properties. These antistatic properties allow the film to remain entirely flat and to slide smoothly on the manufacturing machines, without showing any tendency to become rolled up, which would run the risk of disrupting or even blocking the entire manufacturing process.

The film can be provided with these antistatic properties on the basis of principles known to those skilled in the art, i.e. either by supplying at least one antistatic agent in at least one of the ingredients (resin and/or binder) forming part of the composition of the film, prior to the manufacture of the film, or by coating the film on its outer layers using a solution of an antistatic agent, or alternatively by any other appropriate means. Antistatic agents from the alkylamine family are known to those skilled in the art.

In general, the coating with an antistatic agent corresponds to a final surface treatment of the film, such that it results in the production of the outer layers of the film.

This coating with an antistatic agent is thus carried out in particular after the optional printing step.

In general, it is not necessary to use coating with an antistatic agent if the film has been metallized.

When it is desired to apply printing and/or metallization to the film, it is preferable to carry out a corona treatment on the film prior to the said printing and/or metallization. Such a corona treatment can be applied to the film according to the invention, on the basis of the principles known to those skilled in the art. Nevertheless, if the film is essentially monolayer or prepared such that its outermost coextruded layers contain at least one polyester, a satisfactory metallization result is obtained even in the absence of a corona treatment.

The film used in the context of the invention can be obtained, for example, by extrusion or coextrusion through a flat die (often referred to as "cast" extrusion) or by blow-moulding extrusion or coextrusion (also known as "tubular" (co)extrusion). The term extrusion applies to the preparation of a monolayer film, whereas the term coextrusion applies to the preparation of a film comprising at least two layers.

In the process of extrusion or coextrusion through a flat die, a flat film is extruded or coextruded and deposited continuously on a cooling cylinder also known as a "chill-roll".

After extrusion or coextrusion through a flat die, the film preferably undergoes monoaxial or biaxial drawing (producing mono- or biorientation respectively) on the basis of the principles known to those skilled in the art. Monoaxial drawing is carried out in the direction of the extrusion or coextrusion ("machine direction"), whereas biaxial drawing is carried out both in the direction of the extrusion or coextrusion and in the direction perpendicular to that of extrusion or coextrusion. The use of the "cast" process makes it possible to benefit from a surfacing effect of the chill roll, leading to a particularly smooth film which consequently has an attractive surface state.

The mono- or biorientation has the effect especially of increasing the density of the film and of lowering its resistance to the flow threshold.

The drawing or the double-drawing can be carried out continuously or "in resumption mode", i.e. after the film has been wound on a reel and stored momentarily immediately after having been extruded or coextruded or after having undergone a first drawing.

In the blow-moulding extrusion or coextrusion process, the film is extruded or coextruded in the form of a cylindrical bubble obtained by blowing from a circular die. For this process, the drawing rate can range from 2 to 50 and preferably from 10 to 30, the blowing rate can range from 1 to 10 and preferably from 1.5 to 3 and the air-gap can range from 0.5 to 5 mm and

preferably from 0.8 to 1.6 mm. The drawing speed can be varied in order to have an influence on the thickness of the film. Generally, the drawing speed can range from 10 to 150 m/min and preferably from 30 to 60 m/min.

When it is desired to carry out a double-drawing which is very sensitive on the film, the extrusion or coextrusion can be carried out by applying the "double-bubble" process, the two "bubbles" of the said process being produced one after the other, generally continuously.

EXAMPLE 1

An example of the production and use of a three-layer film of the polyester/polyolefin/polyester type is now described. In this example, the starting materials are denoted by the abbreviations whose meanings are given in this table:

ABBREVIATION	NATURE	ORIGIN	BRAND NAME
PETG	Polyethylene terephthalate glycol (modified with 1,4-cyclohexane-dimethanol)	Eastman	Eastar 6763
MDPE	Medium-density polyethylene	BASF	Lupolen 3220 K
HDPE	High-density polyethylene	DSM	Stamylex 9089F
Terpolymer	Ethylene/acrylic ester/maleic anhydride	DuPont	Bynel CXA 4033
AB	Antiblocking agent in the form of a master mixture comprising 10% by weight of silica and 90% by weight of PET, of brand name Eastar 6763	Eastman	C0047

The three layers of the film are described in this table:

LAYER	WEIGHT PERCENTAGE IN THE FILM	COMPOSITION (% BY WEIGHT)
1st outer layer	20%	95% PETG + 5% AB
Inner layer	60%	50% MDPE + 30% HDPE + 20% terpolymer
2nd outer layer	20%	95% PETG + 5% AB

The film was prepared by tubular coextrusion under the following conditions:

- screw temperature of the PETG/AB mixture:	220°C
- screw temperature of the MDPE/HDPE/terpolymer mixture:	180°C
- die temperature:	190°C
- head temperature:	200°C
- drawing rate:	20
- blowing rate:	2
- air-gap:	1.2 mm
- drawing speed:	40 m/min

The film obtained has a width of 800 mm, a total thickness of 28 µm and a density of about 1.1.

A 60 mm × 90 mm rectangle is cut out from the film and a sweet is wrapped manually by making a twist wrap by rotating the film by 1/2 in one hand relative to the sweet held by the other hand. It is observed that the twist wrap has no pronounced tendency to become undone.

EXAMPLE 2 (comparative)

A 60 mm × 90 mm rectangle is cut out of a bioriented polypropylene film and a sweet is wrapped in the same way as in Example 1. It is observed that the twist wrap has a pronounced tendency to become undone.